US009410702B2

(12) **United States Patent**
Dudebout et al.

(10) **Patent No.: US 9,410,702 B2**
(45) **Date of Patent: Aug. 9, 2016**

(54) **GAS TURBINE ENGINE COMBUSTORS WITH EFFUSION AND IMPINGEMENT COOLING AND METHODS FOR MANUFACTURING THE SAME USING ADDITIVE MANUFACTURING TECHNIQUES**

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 236 days.

(21) Appl. No.: **14/176,686**

(22) Filed: **Feb. 10, 2014**

(65) **Prior Publication Data**

US 2015/0226433 A1 Aug. 13, 2015

(51) **Int. Cl.**
F23R 3/16 (2006.01)
F23R 3/00 (2006.01)
F23R 3/06 (2006.01)

(52) **U.S. Cl.**
CPC . ***F23R 3/16*** (2013.01); ***F23R 3/002*** (2013.01); ***F23R 3/06*** (2013.01);
(Continued)

(58) **Field of Classification Search**
CPC F23R 3/16; F23R 3/002; F23R 3/06; F23R 2900/03041; F23R 2900/03044
USPC 60/752–760
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

3,623,711 A 11/1971 Thorstenson
4,896,510 A * 1/1990 Foltz F23R 3/002 60/757
(Continued)

FOREIGN PATENT DOCUMENTS

CN 101526228 A 9/2009
EP 2246623 A1 11/2010
(Continued)

OTHER PUBLICATIONS

Cerri, G. et al.; Advances in Effusive Cooling Techniques of Gas Turbines, Available online at www.sciencedirect.com—ScienceDirect Applied Thermal Engineering 27 (2007) 692-698, 2006 published by Elsevier Ltd.
(Continued)

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(57) **ABSTRACT**

Disclosed in various exemplary embodiments are turbine engine combustors with effusion and impingement cooling and methods for manufacturing the same. In one exemplary embodiment, disclosed is a combustor for a turbine engine that includes an annular liner portion including a first metering hole positioned on a cold side annular surface of the annular liner portion and an impingement chamber positioned in the annular liner. The impingement chamber connects to an entry hole on the cold side annular surface and includes a cooling air outlet passageway that is angled with respect to a hot side annular surface of the annular liner portion and that connects to an exit hole positioned on the hot side annular surface of the annular liner portion. The first metering hole is connected to the impingement chamber. The cooling air outlet passageway directs the air onto the hot side annular surface and spreads the airflow axially and laterally parallel to the hot side annular surface. Furthermore, a ratio of a radial thickness of the annular liner portion to a diameter of the entry hole is from about 2 to about 6.

13 Claims, 9 Drawing Sheets